

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Polyvinyl chloride insulated cables of rated voltages up to and including
450/750 V –
Part 5: Flexible cables (cords)

Conducteurs et câbles isolés au polychlorure de vinyle, de tension assignée au
plus égale à 450/750 V –
Partie 5: Câbles souples

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IEC 60227-5:2011
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450/750 V –
Part 5: Flexible cables (cords)**

**Conducteurs et câbles isolés au polychlorure de vinyle, de tension assignée au
plus égale à 450/750 V –
Partie 5: Câbles souples**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**POLYVINYL CHLORIDE INSULATED CABLES
OF RATED VOLTAGES UP TO AND INCLUDING 450/750 V –****Part 5: Flexible cables (cords)**

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International Standard IEC 60227-5 has been prepared by IEC technical committee 20: Electric cables.

This third edition of IEC 60227-5 cancels and replaces the second edition published in 1997, Amendment 1 (1997) and Amendment 2 (2003). The document 20/1263/FDIS, circulated to the National Committees as Amendment 3, led to the publication of this new edition.

The main change with respect to the previous edition is as follows:

- Inclusion of a test for long term resistance of insulation to d.c in 4.4.

The text of this standard is based on the following documents:

FDIS	Report on voting
20/1263/FDIS	20/1273/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 60227 series, published under the general title *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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POLYVINYL CHLORIDE INSULATED CABLES OF RATED VOLTAGES UP TO AND INCLUDING 450/750 V –

Part 5: Flexible cables (cords)

1 General

1.1 Scope

This part of IEC 60227 details the particular specifications for polyvinyl chloride insulated flexible cables (cords), of rated voltages up to and including 300/500 V.

All cables comply with the appropriate requirements given in IEC 60227-1 and each individual type of cable complies with the particular requirements of this part.

1.2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE The IEC 60811 series is currently undergoing a revision, which will lead to a restructuring of its parts. A description of this, as well as a cross-reference table between the current and planned parts will be given in IEC 60811-100.

IEC 60227-1:2007, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 60227-2:1997, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 2: Test methods*
Amendment 1 (2003)

IEC 60228, *Conductors of insulated cables*

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*

IEC 60811-1-1:1993, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section 1: Measurement of thickness and overall dimensions – Tests for determining the mechanical properties*
Amendment 1 (2001)

IEC 60811-1-2:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Two: Thermal ageing methods*
Amendment 1 (1989)
Amendment 2 (2000)

IEC 60811-1-4:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Four: Tests at low temperature*
Amendment 1 (1993)
Amendment 2 (2001)

IEC 60811-3-1:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 3: Methods specific to PVC compounds – Section One: Pressure test at high temperature – Tests for resistance to cracking*

Amendment 1 (1994)

Amendment 2 (2001)

IEC 60811-3-2:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 3: Methods specific to PVC compounds – Section Two: Loss of mass test – Thermal stability test*

Amendment 1 (1993)

Amendment 2 (2003)

2 Flat tinsel cord

2.1 Code designation

60227 IEC 41.

2.2 Rated voltage

300/300 V.

2.3 Construction

2.3.1 Conductor

Number of conductors: 2.

Each conductor shall comprise a number of strands or groups of strands, twisted together, each strand being composed of one or more flattened wires of copper or copper alloy, helically wound on a thread of cotton, polyamide or similar material.

The conductor resistance shall not exceed the value given in Table 1, column 5.

2.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/D applied around each conductor.

The insulation thickness shall comply with the specified value given in Table 1, column 1.

The insulation resistance shall be not less than the value given in Table 1, column 4.

2.3.3 Assembly of cores

The conductors shall be laid parallel and covered with the insulation.

The insulation shall be provided with a groove on both sides, between the conductors, to facilitate separation of the cores.

2.3.4 Overall dimensions

The mean overall dimensions shall be within the limits given in Table 1, columns 2 and 3.

2.4 Tests

Compliance with the requirements of 2.3 shall be checked by inspection and by the tests given in Table 2.

2.5 Guide to use

Maximum conductor temperature in normal use: 70 °C.

NOTE Other guidelines are under consideration.

Table 1 – General data for type 60227 IEC 41

1	2	3	4	5
Insulation thickness	Mean overall dimensions^a		Minimum insulation resistance at 70 °C	Maximum conductor resistance at 20 °C
Specified value mm	Lower limits mm	Upper limits mm	MΩ × km	Ω/km
0,8	2,2 × 4,4	3,5 × 7,0	0,019	270

^a The mean overall dimensions have been calculated in accordance with IEC 60719.

Table 2 – Tests for type 60227 IEC 41

1	2	3	4	
Ref. No.	Test	Category of test	Test method described in:	
			IEC Standard ^a	Subclause
1	<i>Electrical tests</i>			
1.1	Resistance of conductors	T, S	60227-2	2.1
1.2	Voltage test on completed cable at 2 000 V	T, S	60227-2	2.2
1.3	Insulation resistance at 70 °C	T	60227-2	2.4
2	<i>Provisions covering constructional and dimensional characteristics</i>		60227-1 60227-2	
2.1	Checking of compliance with constructional provisions	T, S	60227-1	Inspection and manual test
2.2	Measurement of insulation thickness	T, S	60227-2	1.9
2.3	Measurement of overall dimensions	T, S	60227-2	1.11
3	<i>Mechanical properties of insulation</i>			
3.1	Tensile test before and after ageing	T	60811-1-1 60811-1-2	9.1 8.1
3.2	Loss of mass test	T	60811-3-2	8.1
4	<i>Pressure test at high temperature</i>	T	60811-3-1	8.1
5	<i>Elasticity at low temperature</i>			
5.1	Bending test for insulation at low temperature	T	60811-1-4	8.1
6	<i>Heat shock test</i>	T	60811-3-1	9.1
7	<i>Mechanical strength of completed cable</i>			
7.1	Bending test	T	60227-2	3.2
7.2	Snatch test	T	60227-2	3.3
8	<i>Test of flame retardance</i>	T	60332-1	

^a All documents cited in this table refer to the dated editions that are listed in the normative references clause.

3 (Vacant)

4 Cord for indoor decorative lighting chains

4.1 Code designation

60227 IEC 43.

4.2 Rated voltage

300/300 V.

4.3 Construction

4.3.1 Conductor

Number of conductors: 1.

The conductor shall comply with the requirements given in IEC 60228 for Class 6 conductors.

4.3.2 Insulation

The insulation shall be polyvinyl chloride of the type PVC/D, it shall consist of two layers and applied by dual extrusion around the conductor.

The outer layer of insulation shall be of a colour contrasting with that of the inner layer but shall adhere to the inner layer.

The combined thickness of the inner and outer layer of insulation shall comply with the overall thickness specified in Table 5, columns 3 and 4, but at no point the thickness of either layer shall be less than the value specified in column 2.

The insulation resistance at 70 °C shall be not less than the values given in Table 5, column 7.

4.3.3 Cord identification

Preferred colour of outer layer: green.

4.3.4 Overall diameter

The mean overall diameter shall be within the limits given in Table 5, columns 5 and 6.

4.4 Tests

4.4.1 General

Compliance with the requirements of 4.3 shall be checked by inspection and by the tests given in Table 6, and additionally by the test for long term resistance of insulation to d.c., as given in 4.4.2.

4.4.2 Long term resistance of insulation to d.c.

a) Test sample

Carry out the test on a sample of cable of 5 m length from which all coverings have been removed. The cores of flat unsheathed cords shall not be separated.

For cables having up to five cores, each core shall be tested. For multicore cables having more than five cores, one core of each colour in the cable shall be tested, and where the number of colours is less than 5, duplicate coloured cores shall be tested as necessary to bring the number of cores tested up to a minimum of 5.

Take care to avoid damage to the core(s) during removal of the coverings.

b) Procedure

Immerse the sample in an aqueous solution of sodium chloride having a concentration of 10 g/l and a temperature of $(60 \pm 5) ^\circ\text{C}$, with a length of about 250 mm at each end of the sample projecting above the solution. Connect the negative pole of a 220 V d.c. supply to the conductor(s) of the sample and the positive pole to a copper electrode immersed in the solution, for a period of 240 h.

c) Requirement

No breakdown of the insulation shall occur during the test and, after the test, the exterior of the insulation shall show no sign of damage.

Discoloration of the insulation should be ignored.

4.4.3 (Vacant)

4.5 Guide to use

Maximum conductor temperature in normal use: 70 °C.

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Table 3 – General data for type 60227 IEC 43
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1	2	3	4	5		6	7
Nominal cross-sectional area of conductor	Thickness of each layer of insulation	Overall insulation thickness	Overall insulation thickness	Mean overall diameter ^a			Minimum insulation resistance at 70 °C
mm ²	Minimum value mm	Minimum value mm	Mean value mm	Lower limit mm	Upper limit mm		MΩ × km
0,5	0,2	0,6	0,7	2,3	2,7		0,014
0,75	0,2	0,6	0,7	2,4	2,9		0,012

^a The mean overall dimensions have been calculated in accordance with IEC 60719.

Table 4 – Tests for type 60227 IEC 43

1	2	3	4	
Ref. No.	Tests	Category of test	Test method described in:	
			IEC Standard ^a	Subclause
1	<i>Electrical tests</i>			
1.1	Resistance of conductors	T, S	60227-2	2.1
1.2	Voltage test on completed cable at 2 000 V	T, S	60227-2	2.3
1.3	Insulation resistance at 70 °C	T	60227-2	2.4
1.4	Long term resistance of insulation to d.c.	T	60227-5	4.4.2
2	<i>Constructional/dimensional characteristics</i>		60227-1 60227-2	
2.1	Compliance with constructional provisions	T, S	60227-1	Inspection and manual tests
			60227-5	4.3
2.2	Measurement of insulation thickness of inner layer (minimum thickness only)	T, S	60227-2	1.9
2.3	Measurement of insulation thickness of outer layer (minimum thickness only)	T, S	60227-2	1.9
2.4	Measurement of overall thickness ^b	T, S	60227-2	1.9
2.5	Measurement of overall diameter	T, S	60227-2	1.11
3	<i>Mechanical properties of insulation</i>			
3.1	Tensile test before ageing ^b	T	60811-1-1	9.1
3.2	Tensile test after ageing ^b	T	60811-1-2	8.1.3.1
3.3	Loss of mass test ^b	T	60811-3-2	8.1
4	Pressure test at high temperature ^b	T	60811-3-1	8
5	<i>Elasticity at low temperature</i>			
5.1	Bend test for insulation ^b	T	60811-1-4	8.1
6	<i>Heat shock test^b</i>	T	60811-3-1	9.1
7	<i>Test of flame retardance</i>	T	60332-1	–

^a All documents cited in this table refer to the dated editions that are listed in the normative references clause.

^b Because of the simultaneous extrusion of the same compound for both layers of insulation, the composite layer shall be tested as one layer and evaluated accordingly.

5 Light polyvinyl chloride sheathed cord

5.1 Code designation

60227 IEC 52.

5.2 Rated voltage

300/300 V.

5.3 Construction

5.3.1 Conductor

Number of conductors: 2 and 3.

The conductors shall comply with the requirement given in IEC 60228 for class 5.

5.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/D applied around each conductor.

The insulation thickness shall comply with the specified value given in Table 5, column 2.

The insulation resistance shall be not less than the values given in Table 5, column 6.

5.3.3 Assembly of cores

Circular cord: the cores shall be twisted together.

Flat cord: the cores shall be laid parallel.

5.3.4 Sheath

The sheath shall be polyvinyl chloride compound of type PVC/ST 5 applied around the cores.

The sheath thickness shall comply with the specified value given in Table 5, column 3.

The sheath may fill the spaces between the cores, thus forming a filling, but it shall not adhere to the cores. The assembly of cores may be surrounded by a separator, which shall not adhere to the cores.

The assembly of circular cord shall have a practically circular cross-section.

5.3.5 Overall dimensions

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The mean overall diameter of circular cords and the mean overall dimensions of flat cords shall be within the limits given in Table 5, columns 4 and 5.

5.4 Tests

Compliance with the requirements of 5.3 shall be checked by inspection and by the tests given in Table 6.

5.5 Guide to use

Maximum conductor temperature in normal use: 70 °C.

NOTE Other guidelines are under consideration.

Table 5 – General data for type 60227 IEC 52

1	2	3	4	5	6
Number and nominal cross-sectional area of conductors	Thickness of insulation	Thickness of sheath	Mean overall dimensions ^a		Minimum insulation resistance at 70 °C
mm ²	Specified value mm	Specified value mm	Lower limit mm	Upper limit mm	
2 × 0,5	0,5	0,6	4,6 or 3,0 × 4,9	5,9 or 3,7 × 5,9	0,012
2 × 0,75	0,5	0,6	4,9 or 3,2 × 5,2	6,3 or 3,8 × 6,3	0,010
3 × 0,5	0,5	0,6	4,9	6,3	0,012
3 × 0,75	0,5	0,6	5,2	6,7	0,010

^a The mean overall dimensions have been calculated in accordance with IEC 60719.

Table 6 – Tests for type 60227 IEC 52

1	2	3	4	
Ref. No.	Test	Category of test	Test method described in	
			IEC Standard ^a	Subclause
1	<i>Electrical tests</i>			
1.1	Resistance of conductors	T, S	60227-2	2.1
1.2	Voltage test on cores at 1 500 V	T, S	60227-2	2.3
1.3	Voltage test on completed cable at 2 000 V	T, S	60227-2	2.2
1.4	Insulation resistance at 70 °C	T	60227-2	2.4
2	<i>Provisions covering constructional and dimensional characteristics</i>		60227-1 60227-2	
2.1	Checking of compliance with constructional provisions	T, S	60227-1	Inspection and manual tests
2.2	Measurement of insulation thickness	T, S	60227-2	1.9
2.3	Measurement of sheath thickness	T, S	60227-2	1.10
2.4	Measurement of overall dimensions:			
2.4.1	– mean value	T, S	60227-2	1.11
2.4.2	– ovality	T, S	60227-2	1.11
3	<i>Mechanical properties of insulation</i>			
3.1	Tensile test before and after ageing	T	60811-1-2	9.1 8.1
3.2	Loss of mass test	T	60811-3-2	8.1
4	<i>Mechanical properties of sheath</i>			
4.1	Tensile test before and after ageing	T	60811-1-2	9.2 8.1
4.2	Loss of mass test	T	60811-3-2	8.2
5	<i>Pressure test at high temperature</i>			
5.1	Insulation	T	60811-3-1	8.1
5.2	Sheath	T	60811-3-1	8.2
6	<i>Elasticity and impact strength at low temperature</i>			